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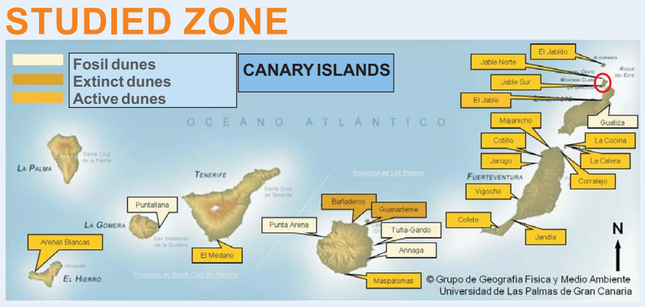
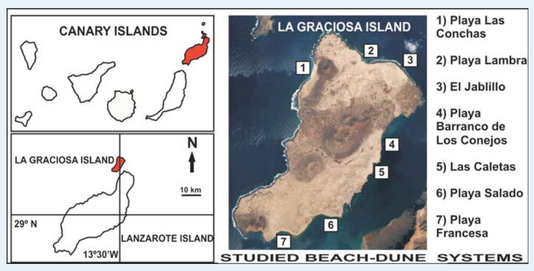
PETROGRAPHY AND SEDIMENTOLOGY OF AEOLIAN SANDS: A TOOL TO DIAGNOSE THE SEDIMENTARY DEFICIT IN LA GRACIOSA ISLAND (NATURAL PARK OF ARCHIPIELAGO CHINIJO, CANARY ISLANDS, SPAIN)

STUDIED ZONE

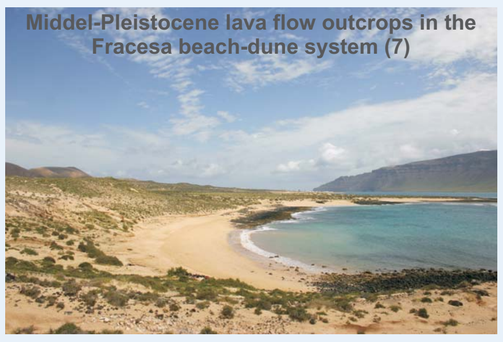


The Canary archipelago has mainly beach-dune systems in the eastern islands which present a remarkably ecological (protected natural areas) and economical (tourism industry) interest.



The work has been carried out in the beach-dune systems of La Graciosa Island (its area is 29 Km2): 1) Playa Las Conchas, 2) Playa Lambra and 3) El Jablillo (in the North), and 4) Barranco de Los Conejos, 5) Las Caletas, 6) Playa Salado and 7) Playa Francesa (in the South).


Lambra beach-dune system (2)


Middel-Pleistocene lava flow outcrops in the Fracesa beach-dune system (7)

From a geological point of view, La Graciosa is formed by ultramafic and maphic lava flows and pyroclasts, middle Pleistocene and Holocene in age, and the half of its surface is upholstered by sand aeolian deposits.


Upper-Pleistocene volcanic cones of Las Agujas (<30.000 years BP) and Las Caletas beach-dune system (5)

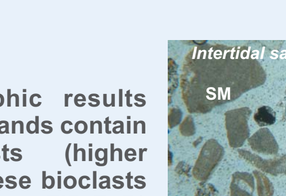
These aeolian sands are spread out in two areas, one of them to the North and the other to the South of the island, and they are divided by a NE-SW belt composed of the volcanic cones of Morros Negros, Morros de Pedro Barba, Las Agujas and Montaña del Mojón.


Holocene volcanic cone of Montaña Bermeja and Las Conchas beach-dune system (1)

METHODOLOGY

Over the last decades, some beaches of the island show the evidence of a sedimentary deficit. These sandy environments are essential for preservation of protected area and for the tourist activity. In this context, our research teams are developing several multidisciplinary projects for elaborating a diagnosis on this situation applying a

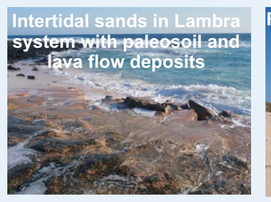

El Salado beach-dune system (6) and its beachrock


Las Caletas beach-dune system (6) and sedimentary beds

For this it is important, among other things, to characterize the sands to determine the area source of these sediments, with the purpose of studying the causes of this sedimentary deficit in depth. This is the aim of the research presented, whose methodology is based on the petrography and sedimentology (grading and calcimetry) of 27 sand samples, which have been selected from several environmental units of these systems: intertidal, foredune, hummock dune and aeolian sand.


El Salado beachrock and an aeolianite bed


Intertidal sands in the El Salado system


Intertidal sands in Lambra system with paleosoil and lava flow deposits


Fore dune in Lambra system

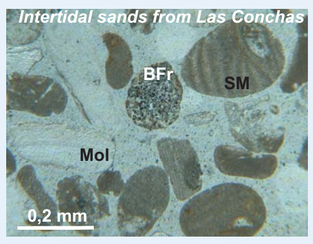

Fore dune in El Salado system

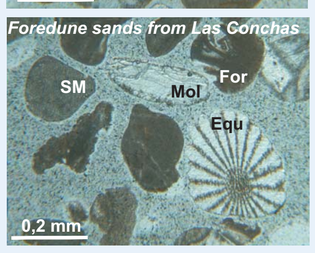

Aeolian sands in El Salado system


Hummock dunes in Lambra system

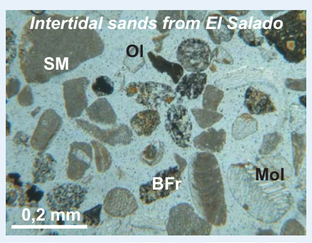

Aeolian sands in Lambra system

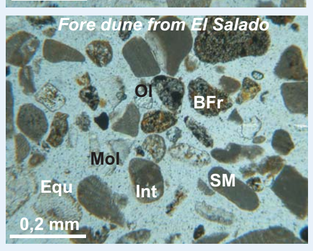
PETROGRAPHIC STUDY



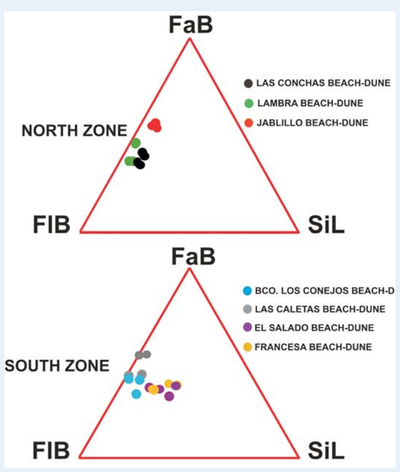


The petrographic results show that the sands contain mainly bioclasts (higher than 75%.). These bioclasts (Flora and Fauna: FIB-FaB) are mainly fragments of seaweed meshes (SM) and mollusks (M) and, in a minor proportion, foraminifers (For), equinoderms (equ), gastropods and bryozoes. These bioclasts meanly come from the coastal and shallow platform environments.

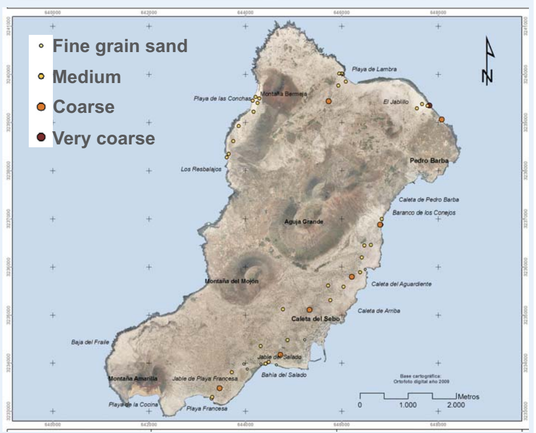


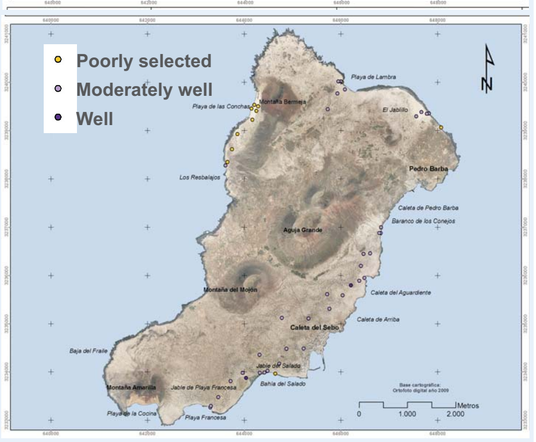


The lithoclasts are more scarce and they are constituted by fragments of volcanic rocks (basanite and basalt: BFr) and minerals (olivine-Ol, augite, feldspar and Fe-Ti oxide) (SiL), together with some grains of volcanic glass and sedimentary intraclasts (Int). These lithoclasts are originated by the erosion of the volcanic and sedimentary materials.



El Salado and Playa Francesa systems have abundance less than 25% of lithoclasts (SiL); Playa de Las Conchas, Jablillo and Barranco de Los Conejos show less than 13% and Lambra and Las Caletas have less than 5%.





SEDIMENTOLOGIC ANALYSES

The sedimentologic analyses confirm that the sands are very carbonated (calcimetric values higher than 84%) and the sand grains have medium size (between 0.25 and 0.5 mm), although some samples are coarse sand (between 0.5 and 1 mm) and fine sand (<0.25 mm).

LAS CONCHAS SAMPLES	ZONE	PETROGRAPHY (%) FIB	FaB	SiL	INT	STATISTICAL COEFFICIENTS M SIZE	SORT	ASIM	KUR	CALC
GRAC-54	Intertidal	49,6	32,3	7,3	10,6	0,421	0,44	-0,616	0,96	94,3
GRAC-55	Foredune	46,3	35,9	9,2	8,3	0,404	0,419	0	0,982	85,7
GRAC-58	Hummock dune	45,3	36,9	6,9	10,6	0,401	0,366	0,9	1,105	91
GRAC-60	Hummock dune	51,3	32,5	9,5	6,3	0,393	0,39	0,052	0,979	84

LAMBRA SAMPLES	ZONE	PETROGRAPHY (%) FIB	FaB	SiL	INT	STATISTICAL COEFFICIENTS M SIZE	SORT	ASIM	KUR	CALC
GRAC-1	Intertidal	53,6	33,2	3,6	9,3	0,46	0,47	0,04	0,885	95,7
GRAC-2	Supratidal	52	33,5	5,2	9	0,53	0,414	0,198	0,982	98,3
GRAC-3	Foredune	47,6	42,2	2,2	7,6	0,482	0,501	0,045	0,994	95,9
GRAC-4	Hummock dune	46,3	41,9	2,2	9,3	0,462	0,571	0,05	1,031	96,3

Their sorting varies between well selected (0.35 and 0.5) and moderately well selected (0.5-1), and some samples are poorly selected.
The systems studied show composition and texture diversity due to the source areas of the sands are different and the environmental conditions vary.

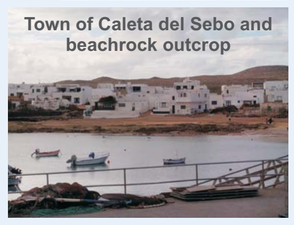
LAS CALETAS SAMPLES	ZONE	PETROGRAPHY (%) FIB	FaB	SIL	INT	STATISTICAL COEFFICIENTS M SIZE	SORT	ASIM	KUR	CALC
GRAC-45	Foredune	49	37,9	1	12	0,418	0,587	0,07	0,923	94,6
GRAC-49	Hummock dune	38,3	50,1	3,2	8	0,575	1,229	-0,316	1,079	93,1
GRAC-50	Aeolian sand	40	47,3	0,3	12,3	0,393	0,685	-0,123	1,132	95,2
GRAC-51	Aeolian sand	43	38,2	5,6	13	0,437	0,908	0,006	1,084	89,6

EL SALADO SAMPLES	ZONE	PETROGRAPHY (%) FIB	FaB	SiL	INT	STATISTICAL COEFFICIENTS M SIZE	SORT	ASIM	KUR	CALC
GRAC-29	Intertidal	33,3	34,9	23,5	7,9	0,26	0,761	-0,354	1,152	75,5
GRAC-26	Foredune	38,6	29,2	22,5	9,3	0,471	1,125	-0,156	0,692	78,8
GRAC-23	Aeolian sand	45	33,6	12,5	8,6	0,408	0,931	-0,172	1,079	86,7
GRAC-24	Aeolian sand	39,6	31,6	16,2	12,3	0,746	0,936	0,431	1,307	85,9

CHARACTERIZATION OF SAND GRAINS AND POSSIBLE CAUSES OF SAND DEFICIT

The petrography and sedimentology of sands from beach-dune systems in La Graciosa island confirm that the grains are very carbonated and contain mainly marine bioclasts (>75%). In addition, these grains are medium sized and sorting is moderately well selected.
However, each studied beach-dune system has different geological characteristics due to the fact that the source areas of the sands are different and the enviromental conditions vary.

The sand deficit in the beach-dune systems of La Graciosa could be due to a decrease of marine flora and fauna productions (less bioclast grains) by natural or antropogenic causes susch as global changes of climatic or oceanografic conditions, or local marine water contamination, among others.
It is possible to observe that the actual reception of the sand in the studied beaches is minimun if compared with the aeolian sand deposits found in the interior of the island. Thus, beachrock and paleosoil beds, and aeolinaites deposits sometimes outcrop on the intertidal and supratidal environments.


Town of Caleta del Sebo and beachrock outcrop


Illegal sand quarry in the Caleta del Sebo outside

The most significant example of sedimentary deficit is in El Salado beach-dune system.
Thus, a drastic change of island economy exists in the last decades towards the turistic activity. This implies an important growth of the town of Caleta del Sebo and the building surface has doubled from 1977 to 2009. In addition, there are some illegal sand quarries used for several constructions.
Caleta del Sebo town affects the aeolian dynamic in this part of the island and its seaport interferes with marine dynamics.

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